Claims

1. A boom assembly including a boom support frame, a boom section pivotally connected to the boom support frame for movement between a working position and a breakaway position, a hydraulic breakaway cylinder having a first condition for maintaining the boom section in the working position and a breakaway condition permitting movement of the boom section towards the breakaway position when the boom section encounters an obstacle, hydraulic valve structure connected to the breakaway cylinder, an accumulator connected to the breakaway cylinder, wherein the hydraulic valve structure and the accumulator provide staged pressure control of breakaway cylinder operating pressure to absorb energy as the boom section moves from the working position, the staged pressure increasing as the boom section approaches the breakaway position to limit momentum of the boom section.

2. The boom assembly as set forth in claim 1 wherein the boom section comprises an inner wing of an agricultural sprayer boom.

3. The boom assembly as set forth in claim 1 wherein the accumulator and the hydraulic valve structure are connected to an end of the breakaway cylinder, the breakaway cylinder assuming an extended condition when the boom section is in the working position and a retracted position when the boom section is in the breakaway position.

4. The boom assembly as set forth in claim 1 wherein the accumulator and the hydraulic valve structure define a first stage wherein the accumulator absorbs energy from the boom section upon the boom section encountering the obstacle.

5. The boom assembly as set forth in claim 1 wherein the accumulator and the hydraulic valve structure define a full breakaway stage wherein the accumulator absorbs energy from the boom as the boom approaches the breakaway position.

6. The boom assembly as set forth in claim 4 wherein the accumulator and the hydraulic valve structure define an intermediate stage wherein the valve structure provides resistance to flow of breakaway cylinder hydraulic flow to absorb energy from the boom section when the boom section is between the working and breakaway positions.

7. The boom assembly as set forth in claim 5 wherein the accumulator and the hydraulic valve structure define an intermediate stage wherein the valve structure provides resistance to flow of breakaway cylinder hydraulic flow to absorb energy from the boom section when the boom section is between the working and breakaway positions.

8. The boom assembly as set forth in claim 1 wherein during at least one of the stages the hydraulic valve structure controls absorption of energy from the boom section and during another of the stages the accumulator provides absorption of energy from the boom section.

9. The boom assembly as set forth in claim 1 wherein the hydraulic valve structure provides absorption of the energy at an intermediate position of boom section by restricting hydraulic fluid flow relative to the breakaway cylinder at the intermediate position, and the accumulator provides absorption of the energy as the boom section approaches the breakaway position.

10. The boom assembly as set forth in claim 1 wherein the hydraulic valve structure provides absorption of the energy at an intermediate position of boom section by restricting hydraulic fluid flow relative to the breakaway cylinder at the intermediate position and the accumulator provides an initial absorption of the energy as the boom section encounters the obstacle and begins to move away from the working position.

11. The boom assembly as set forth in claim 1 wherein the hydraulic valve structure includes a relief valve connected to the breakaway cylinder and responsive to pressure in the breakaway cylinder, the accumulator providing substantially all the absorption of energy until the relief valve responds to increasing pressure in the breakaway cylinder.

12. The boom assembly as set forth in claim 1 including a second boom section pivotally connected to the boom support frame and to the breakaway cylinder, wherein the accumulator and the hydraulic circuit provide energy absorption for the second boom section when the second boom section encounters obstacles.

13. The boom assembly as set forth in claim 12 including a rocker assembly connecting the breakaway cylinder to both the boom sections.

14. The boom assembly as set forth in claim 13 further comprising fold cylinder structure connected between the rocker assembly and the boom sections for moving the boom sections from the working position to a folded transport position.

15. A boom assembly including a boom support frame, a boom section pivotally connected to the boom support frame for movement between a working position and a breakaway position, a hydraulic breakaway cylinder connected to the boom section, the breakaway cylinder having a cylinder stroke dependent on boom section position, an accumulator connected to the breakaway cylinder to provide an increasing cylinder pressure as the boom section moves from the working position towards the breakaway position, and a relief valve connected to the breakaway cylinder, the accumulator and the relief valve defining a cylinder pressure curve which initially increases with cylinder stroke as the boom assembly moves from the working position, the pressure curve generally leveling along an intermediate range of positions of the cylinder stroke and then increasing with cylinder stroke as the boom section approaches the breakaway position.

16. The boom assembly as set forth in claim 15 wherein the boom section comprises in inner boom section.

17. The boom assembly as set forth in claim 15 wherein the breakaway cylinder includes a first port connected to the accumulator and a second port offset in a cylinder stroke direction from the first port and connected to the relief valve, wherein at least one of the first and second ports is blocked during a portion of the cylinder stroke.

18. The boom assembly as set forth in claim 17 wherein the first port remains unblocked during substantially the entire cylinder stroke and the second port is blocked as the boom section approaches the breakaway position.

19. The boom assembly as set forth in claim 17 wherein the hydraulic valve structure and the accumulator provide at least first, second and third stages of pressure control of the breakaway cylinder to absorb energy as the boom section moves from the working position to the breakaway position.

20. A boom assembly including a boom support, a boom section pivotally connected to the boom support for movement between a working position and a

breakaway position, a hydraulic breakaway cylinder biasing the boom section to the working position, valve structure, an accumulator, and means connecting the valve structure and the accumulator to the breakaway cylinder to provide pressure control of breakaway cylinder operating pressure to absorb energy as the boom section moves from the working position, wherein the staged pressure increases as the boom section approaches the breakaway position to limit momentum of the boom section.

21. The boom assembly as set forth in claim 20 wherein the means connecting the valve structure and the accumulator to the breakaway cylinder comprises first and second cylinder ports located on the breakaway cylinder, the breakaway cylinder having a stroke and wherein the ports are offset in a direction of the stroke and during a portion of the stroke at least one of the ports is blocked, and first and second hydraulic lines connecting the accumulator and the valve structure to the first and second ports, respectively.

22. The boom assembly as set forth in claim 20 wherein the valve structure includes a pressure relief valve controlling cylinder pressure over a portion of the stroke, and wherein the accumulator provides an increasing cylinder pressure near an extremity of the stroke.

23. The boom assembly as set forth in claim 22 including means for blocking the valve structure near the extremity of the stroke.

24. The boom assembly as set forth in claim 20 wherein the accumulator provides increasing cylinder pressure with stroke at an initial stroke position and at a final stroke position, and wherein the valve structure defines cylinder pressure at an intermediate stroke location.